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General and Supportive Care

Disability in activities of daily living among adults with cancer: A systematic review and meta-analysis

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ABSTRACT

Introduction: People with cancer frequently report limitation in Activities of Daily Living (ADLs); essential activities required to live independently within society. Although several studies have assessed ADL related disability, variability in assessment, setting, and population means evidence is difficult to interpret. We aimed to determine the prevalence of ADL related disability, overall and by setting, and the most commonly affected ADLs in people living with cancer.

Methods: We searched twelve databases to June 2016 for observational studies assessing ADL disability in adults with cancer. Data on study design, population, ADL instruments and disability (difficulty with or requiring assistance in ≥ 1 activity) were extracted, summarised, and pooled to estimate disability prevalence with 95% confidence intervals (95% CI) overall and by setting.

Results: Forty-three studies comprising 19,246 patients were included. Overall, 36.7% (95% CI 29.8–44.3, 18 studies) and 54.6% (95% CI 46.5–62.3, 15 studies) of patients respectively reported disability relating to basic and instrumental ADLs. Disability was marginally more prevalent in inpatient compared to outpatient settings. The Katz Index (18 studies) and Lawton IADL Scale (11 studies) were the most commonly used instruments. Across the activities studied, the most frequently affected basic ADLs were personal hygiene, walking and transfers, and instrumental ADLs were housework, shopping and transportation.

Conclusions: About one-third and half of adults with cancer respectively have difficulty or require assistance to perform basic and instrumental ADLs. These findings highlight the need for rehabilitation focused on functional independence, and underscore the importance of professionals skilled in occupational assessment and therapy within cancer services.

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Introduction

With advances in screening and therapies, people are increasingly living longer with the consequences of cancer and its treatment. Patients with cancer frequently report a sustained symptom burden, exercise intolerance, and physical deconditioning, all of which can threaten everyday independence [1]. Activities of daily living (ADLs) refer to the essential activities an individual is required to perform to live independently within society [2,3]. Activities are categorized into basic ADLs; referring to personal care activities such as feeding, toileting, washing, and dressing,

as well as instrumental ADLs; referring to extended tasks such as meal preparation, using public transportation, doing household chores, and grocery shopping [4–7]. Performing ADLs is necessary to maintain independent living, well-being and health related quality of life [2,8,9]. Disability relating to ADLs (difficulty with or requiring assistance in at least one activity) has been associated with poorer quality of life, and in older adults is predictive of mortality [10]. It follows therefore, that where disability relating to ADLs exists, addressing it should be a core goal of clinical management.

Although multiple studies assessing ADL disability in cancer have been published, the variability among study populations, settings, and measures makes it difficult to interpret the evidence. Landmark studies have used ADL disability to characterise functional decline at the end of life, for example Lunney et al. [11] observed rapid disability following a high level of ADL performance, and Gill et al. [12] demonstrated more varied trajectories of disability. Whilst these studies highlight the severe impact of

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cancer on ability to manage ADLs, both were limited to a community setting and late phase of illness. Earlier in the cancer trajectory, individuals tend to experience more disability in instrumental ADLs compared to basic ADLs [13,14], which supports the notion that instrumental ADLs require a higher level of functional ability [15]. Evidence regarding which activities are most commonly affected in cancer questions the original hierarchy of ADL proposed by Katz. For example, both eating [16] and bathing [13] are commonly affected by cancer, despite these tasks being considered the easiest and most difficult ADLs respectively [5,17].

To our knowledge, no review has systematically examined ADL-related disability in adults living with cancer. A better understanding of disability profiles and patterns regarding ADLs, including in the context of cancer stage and settings, would allow clinicians to target rehabilitation interventions, shape policy around rehabilitation services, and equip researchers with a knowledge base on which to develop treatments to reduce ADL disability. This review aimed to identify instruments, items, and reporting of ADL disability in people with cancer; to determine the prevalence of ADL disability overall and by setting; and describe the most commonly affected basic and instrumental ADLs in this group.

Method

Design

The systematic review was planned in accordance with the Centre for Reviews and Dissemination [18] guidance on conducting reviews and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [19].

Inclusion and exclusion criteria

Studies of adult populations (≥ 18 years), with a primary clinical or histological diagnosis of cancer were included. Studies of paediatric populations (< 18 years) were excluded as they are recognized as a distinct population with different ADL requirements from adults. Cancer survivors were also excluded as the term survivor has been defined in multiple ways, from those living with cancer to those cured and free of any disease [20]. Studies employing any measure of ADL disability were included. We did not consider studies only employing measures of global functional status, e.g. ECOG Performance Status, or physical limitation, e.g. walk tests. All prospective and retrospective observational study designs were eligible, including cohort studies, cross-sectional studies, longitudinal studies, case series, and chart reviews.

Search strategy

An electronic search strategy using a combination of full-text search terms and MeSH terms was developed for MEDLINE and adapted where necessary for all other databases. Search terms included “cancer” or “carcinoma” AND “functional disabilities”, “functional outcomes” or “functional impairment” AND “observational studies”, “cohort studies” or “longitudinal studies”. All search terms were used as full-text, with use of truncation symbol to retrieve variations in the terminology. (Supplement, Appendix 1.)

A systematic literature search was conducted in 12 electronic databases from inception to June 2016: MEDLINE; EMBASE; CINAHL; ASSIA (Applied Social Sciences Index and Abstracts); PsycINFO; Social Policy and Practice; IBBS (International Bibliography of the Social Science); Science Direct; Social Service Abstract; Sociological Abstract; Scopus; Web of Science Core Collection. Grey literature was searched on six databases: OpenGrey (System for

Information on Grey Literature); ProQuest Dissertations & Theses; Web of Science Conference Proceedings; Scopus Conference Proceedings; HMC (Health Management Information Consortium); Global Health. No time restrictions were applied. Restrictions were applied to studies in human subjects published in English language.

Search alerts were set up regularly for updates of relevant new publications in each database up to November 2016, and hand searching was conducted up to October 2016. The first author (J.N.) scanned reference lists, and performed forward and backward citation tracking of included studies. Experts in the field of cancer and disability were also contacted via email to seek potentially relevant research material, including ongoing and unpublished research.

Data collection and analysis

Selection of studies

An online reference management system (Refworks) was used to manage electronic database hits and remove duplicates. Eligibility criteria were first applied to the title and abstracts. Full-text articles were retrieved for titles/abstracts that meet the review criteria or when information in the title and abstract was insufficient to determine eligibility. The appraisal of articles against inclusion and exclusion criteria was agreed between the first (J.N.) and last (M.M.) authors, with any disagreements regarding the studies resolved via discussion.

Assessment of methodological quality in included studies

Studies selected for inclusion of specific items of ADL disability were assessed for methodological quality using Loney's critical appraisal tool [21], designed to assess quality and susceptibility to bias in articles determining the incidence or prevalence of a clinical issue. The tool covers eight criteria; description of study subjects, random sample, unbiased sampling frame, adequate sample size, standardised measures, unbiased assessors, adequate response rate, and confidence intervals and subgroup analysis. A point is allocated for the presence of each criterion. A higher score indicates higher methodological quality.

Data extraction and analysis

A standardised data extraction form was developed, piloted, and data from eligible studies was extracted (J.N. and M.M.) to retrieve data on study design, setting, sample characteristics, instruments of ADL disability, and characteristics of ADL related disability.

Normally distributed variables were summarised by mean and standard deviation. For studies with multiple subgroups within the sample, data were aggregated into a single group using the formula devised by the Cochrane Collaboration for combining means and standard deviations of groups [22]. Where mean was not reported, mean and standard deviation was estimated from its median and range using the formula devised by Hozo and colleagues [23]. When the range was not available for calculation of mean, median was assumed as mean for studies of sufficiently large sample size. Categorical variables e.g. cancer type, were summarised by percentage of participants in the highest occurring category.

Data on overall and specific ADL disability prevalence were summarised by mean and 95% confidence intervals calculated using Wilson's method (Confidence Interval Analysis version 2.1.2 software). Disability prevalence was determined overall, and by inpatient/outpatient setting as patients admitted to hospital or care home might be more dependant in ADLs. Data on number of ADL disability and total ADL disability score were summarised as mean and standard deviations. Figures were

produced using Graphpad Prism software 7.0b. A meta-analysis was conducted to synthesise the results from multiple studies into a single prevalence point for disability relating to basic and instrumental ADLs, overall and by setting, using Cochrane Collaboration's RevMan software [22].

Results

Study retrieval

Our search of the literature retrieved 13,432 articles. After de-duplication and title/abstract screening, 83 full-text articles were retrieved for further appraisal, of which 43 separate studies were included (Fig. 1, see Supplement, Appendix 2 for excluded studies). All studies were included for narrative review of instruments and

items of ADL disability. Data from eighteen and fifteen studies respectively were used for meta-analyses for pooled estimates of basic ADL and instrumental ADL disability.

Characteristics of included studies and sample participants

See Table 1 for information on characteristics of all included studies. Most studies were conducted from 2000 onwards ($n = 32$), in the US and Canada ($n = 21$), Europe ($n = 19$), or Asia ($n = 3$). The majority of studies ($n = 24$) recruited participants from outpatient settings, e.g. home care, clinics, or community-dwelling adults. Data from a total of 19,246 participants were available, with individual study samples sizes ranging from 45 to 6822. Participants were heterogeneous with regards to primary cancer type (breast, colorectal, lung, gastrointestinal, etc.) and cancer treatment status.

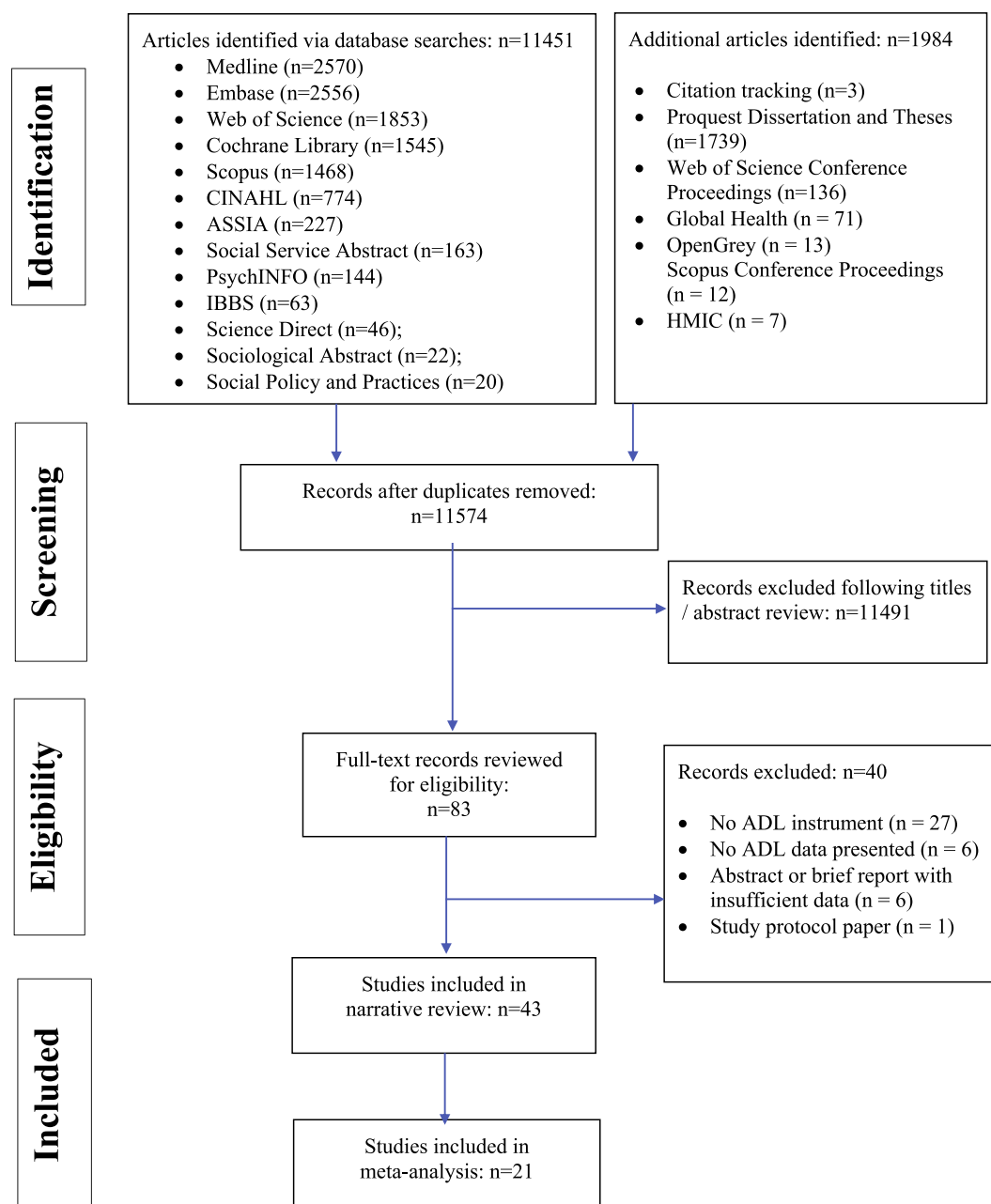


Fig. 1. PRISMA flow diagram.

Table 1
Characteristics of included studies for narrative review.

| First author/year/ country | Study design | Setting | ADL outcome measures | Sample characteristics | | | | | | | |
|--------------------------------------|----------------------------------|------------|---------------------------------------|--------------------------------|---------------------------|----------|---------------|------------------------------|----------------------------|-------------------|-----------------|
| | | | | Sample size (n) | Age Mean \pm SD (years) | Male (%) | Ethnicity (%) | Cancer type (% of sample) | Cancer stage (% of sample) | PS (%) | Treatment (%) |
| Bentley 2013 UK [24] | Cross-sectional | Outpatient | Occupational Performance Problem List | 260 | 71 \pm 10 | 62 | White (90) | NSCLC (81) | NSCLC IV (55) | ECOG 0 (28) | Palliative (79) |
| Chen 2007 USA [25] | Retrospective cohort | Inpatient | MDS – ADL | 63 | 91 \pm 6 | 33 | ns | ns | ns | ns | ns |
| Cheville 2008 USA [26] | Cross-sectional | Outpatient | OARS – ADL and IADL | 163 | 56 \pm 1 | 0 | White (71) | Breast (100) | IV (26) | ns | ns |
| Cole 2000 USA [27] | Retrospective case series | Inpatient | FIM Motor Measure | 200 | 71 \pm 12 | 46 | ns | Blood-related (17) Lung (17) | III (72) | ns | Curative (76) |
| Corsonello 2010 Italy [28] | Observational | Inpatient | Katz ADL | 1398 | 65–79 years (45%) | 63 | ns | GI (30) | NA | ns | ns |
| Deckx 2015 Belgium; Netherlands [29] | Prospective observational cohort | Inpatient | Katz ADL Lawton IADL | 134 | 77.1 ^b | 21 | ns | Breast (69) | II (54) | ns | Surgery (93) |
| Deeg 2005 Netherlands [30] | Prospective longitudinal | Outpatient | OECD – 3 activities | 254 | ns | ns | ns | ns | ns | ns | ns |
| de Miguel Sánchez 2006 Spain [31] | Prospective longitudinal | Outpatient | Katz ADL | 98 | 72 \pm 12 | 61 | ns | GI (28) | Metastases (87) | PPS score 50 (33) | ns |
| Derks 2004 Netherlands [32] | Prospective longitudinal | Outpatient | ADL and IADL questionnaires | 121 | 45–60 years (61%) | 64 | ns | Oral cavity (46) | ns | KPS 90–100 (87) | Surgical (76) |
| Echteld 2004 Netherlands [33] | Prospective longitudinal | Inpatient | RAI-MDS-PC | 355 | 73 \pm 13 | 45 | ns | Lung (20) | ns | ns | ns |
| Extermann 1998 USA [34] | Prospective cohort | Outpatient | Katz ADL Lawton IADL | 203 | 76 \pm 8 ^a | 39 | ns | Breast (34) | Metastatic (47) | ECOG 1 (53) | ns |
| Finalyson 2012 USA [35] | Retrospective cohort | Inpatient | MDS – ADL | 6822 | 83 \pm 8 | 32 | White (86) | ns | ns | ns | ns |
| Flood 2006 USA [36] | Retrospective descriptive | Inpatient | Katz ADL Lawton IADL | 96 (Katz ADL) 91 (Lawton IADL) | 74 \pm 6 | 48 | White (77) | Lung (30) | ns | ns | ns |
| Gill 2010 USA [12] | Longitudinal | Outpatient | 4-item ADL questionnaire | 74 | 82 \pm 5 | 39 | White (91) | ns | ns | ns | ns |
| Girones 2012 Spain [37] | Prospective | Outpatient | 5-item Katz ADL Lawton IADL | 83 | 77 \pm 5 | 98 | ns | NSCLC (76) | III (41) | ECOG 1 (40) | ns |
| Given 1994 USA [38] | Prospective longitudinal | Outpatient | Katz ADL Lawton IADL | 111 | 63 \pm 7 | 50 | ns | GI (29) | ns | ns | CT + Other (78) |

(continued on next page)

Table 1 (continued)

| First author/year/ country | Study design | Setting | ADL outcome measures | Sample characteristics | | | | | | | |
|------------------------------------|----------------------------------|------------|--------------------------------------|------------------------|---------------------------|----------|---------------------------|---------------------------|----------------------------|----------------------|--------------------|
| | | | | Sample size (n) | Age Mean \pm SD (years) | Male (%) | Ethnicity (%) | Cancer type (% of sample) | Cancer stage (% of sample) | PS (%) | Treatment (%) |
| Greimel 2000 Austria [39] | Prospective | Outpatient | ALLTAG | 98 | 56 \pm 13 ^a | 0 | ns | Cervical (47) | ns | ns | Surgery (51) |
| Guadagnoli 1991 USA [40] | Cross-sectional | Outpatient | Telephone interviews on ADL/IADL | 413 | 65–75 years (29%) | 29 | White (98) | Breast (47) | ns | ns | Palliative (63) |
| Hamaker 2011 Netherlands [41] | Prospective observational cohort | Inpatient | Katz ADL Modified Katz IADL | 292 | 78 \pm 9 ^a | 51 | ns | ns | Metastases (43) | ns | ns |
| Huijberts 2016 Netherlands [42] | Prospective cohort | Inpatient | Modified Katz ADL | 151 | 76 \pm 7 | 46 | Dutch (91) | ns | ns | ns | ns |
| Hunter 2012 USA [43] | Retrospective | Inpatient | FIM Motor Measure | 215 | 61 \pm 16 | 49 | ns | ns | ns | ns | ns |
| Hurria 2006 USA [44] | Prospective longitudinal | Outpatient | Katz ADL Lawton IADL | 50 | 71 \pm 6 ^a | 51 | White (80) | Breast (100) | IIA (49) | ns | Lumpectomy (63) |
| Kanesvaran 2014 China [45] | Prospective | Inpatient | 5-item ADL questionnaire OARS – IADL | 803 | 76 \pm 8 ^a | 60 | Han (95) | Lung (33) | IV (56) | ns | CT (44) |
| Kim 2011 Korea [46] | Prospective | Outpatient | MBI Lawton IADL | 65 | 72 \pm 4 ^a | 75 | ns | Colorectal (34) | IV (49) | ECOG 0–1 (89) | Palliative CT (74) |
| Korouklian 2010 USA [47] | Retrospective database review | Outpatient | ADLs recorded in the OASIS | 1009 | 75–79 years (26%) | 43 | Non-African American (92) | Colorectal (100) | Localised (74) | ns | ns |
| Lindahl-Jacobsen 2015 Denmark [48] | Cross-sectional | Inpatient | ADL – Q | 118 | 70 \pm 10 | 35 | ns | Lung (29) | ns | KPS score 50–70 (86) | ns |
| Lindsey 1994 USA [49] | Prospective longitudinal | Outpatient | FAI ADL and IADL | 45 | 72 \pm 7 ^a | 36 | White (91) | Lung (57) | ns | ns | ns |
| Luciani 2008 USA [50] | Retrospective cross sectional | Outpatient | Katz ADL Lawton IADL | 214 | 79 \pm 5 | 37 | ns | ns | ns | ECOG 0 (62) | ns |
| Lunney 2003 USA [11] | Prospective longitudinal | Outpatient | Interview on 7 ADLs | 897 | 78 \pm 7 | 63 | White (80) | ns | ns | ns | ns |
| Marcinak 1996 USA [51] | Retrospective case series | Inpatient | FIM Motor Measure | 159 | 57 \pm 17 | 49 | ns | Primary intracranial (45) | ns | ns | Surgery (86) |
| McCarthy 2000 USA [52] | Prospective cohort | Outpatient | 7-item Modified Katz Index ADL | 1063 | 64 \pm 8 ^a | 61 | White (84) | NSCLC (70) | ns | ns | CT (61) |
| McEwen 2012 Canada [53] | Retrospective record review | Inpatient | FIM Motor Measure | 153 | 73 \pm 13 | 41 | ns | Colorectal (29) | ns | ns | ns |
| Movsas 2003 USA [54] | Prospective cohort | Inpatient | FIM Motor Measure | 55 | 61 \pm 17 ^a | ns | ns | Hematologic (40) | Metastatic (69) | ns | ns |

| | | | | | | | | | | | |
|---------------------------------|--------------------------------|------------|-------------------------------------------------------|------|--------------------------|----|------------|----------------------------------|-----------------|------------------|-------------------------|
| O'Hare 1993 USA [55] | Longitudinal | Outpatient | ESDS | 63 | ≥ 65 years (48%) | 38 | ns | ns | ns | ns | ns |
| Ögce 2008 Turkey [56] | Longitudinal descriptive | Outpatient | IFS-CA | 101 | >50 years (50%) | 0 | ns | Breast (100) | Localised (52) | ns | Mastectomy (98) |
| Repetto 2002 Italy [57] | Prospective cross-sectional | Inpatient | Katz ADL Lawton IADL | 363 | 76 ± 8^a | 46 | ns | Breast (31) | Localised (40) | ECOG < 2 (74) | ns |
| Retornaz 2007 France [58] | Retrospective chart review | Outpatient | Katz ADL 4-item IADL scale | 144 | 79 ± 7 | 46 | ns | Breast (18) | Metastases (75) | ns | None (58) |
| Retornaz 2008 France [59] | Retrospective chart review | Inpatient | Katz ADL 4-item IADL scale | 186 | 80 ± 7 | 48 | ns | Breast (15) | Metastases (71) | ns | None (46) |
| Serraino 2001 Italy [60] | Cross-sectional | Inpatient | Katz ADL | 303 | 76 ± 8^a | 60 | ns | Haematological neoplasia (60) | ns | ECOG 0–1 (62) | ns |
| Silver 2010 Brazil [61] | Prospective longitudinal | Outpatient | Lawton IADL Katz ADL 6-item Lawton IADL | 60 | 61 ± 12 | 88 | White (95) | Mouth (40) | IV (35) | ns | Surgery (82) RT (82) |
| Stafford 1997 USA [62] | Cross-sectional | Outpatient | 6-item ADL questionnaire 6-item IADL questionnaire | 1647 | 75^b | 33 | ns | Breast (24) | ns | ns | ns |
| Tay 2009 Singapore [63] | Prospective cohort | Inpatient | FIM | 58 | 57 ± 16 | 62 | ns | Solid tumour (86) | ns | ns | RT (25.9) |
| Ulander 1997 Sweden [64] | Exploratory | Outpatient | Katz Index and Hulter- Asberg's IADL index | 86 | 70 ± 13 | 54 | ns | Colorectal (100) | Metastases (44) | ns | ns |

All values rounded to the nearest whole number.

ns = not stated.

Abbreviations: ADL: Activities of Daily Living; ADL – Q: Activities of Daily Living Questionnaire; CT: Chemotherapy; ECOG: Eastern Cooperation Oncology Group; GI: Gastrointestinal; IADL: Instrumental Activities of Daily Living; KPS: Karnofsky Performance Status; NHS: National Health Service ; ns; not specified; NSCLC: Non squamous cell lung carcinoma; OT: Occupational therapy; PCU: Palliative Care Unit; RAI – MDS – PC: Resident Assessment Instrument – Minimum Data Set – Palliative Care; RAI-PC: Inter Resident Assessment Instrument – Palliative Care; PPS: Palliative Performance Scale; PS: Performance status; SF-36: 36-Item Short Form Health Survey.

^a Means estimated using median, range, and sample size Hozo et al. [23].

^b SD not specified in study

Instruments, items and reporting of ADL disability

In all studies, ADL disability was defined as having difficulty with or requiring assistance in at least one activity. Most studies used standardised and validated instruments, however, close to one-quarter of studies ($n = 9/43$) used questionnaires and/or scales constructed specifically for the study, with items from a parsimonious selection of ADL. The most commonly used ADL instruments were the Katz Index of Independence to assess basic ADLs ($n = 18$), and the Lawton IADL scale ($n = 11$) to assess for instrumental ADLs. For both measures, deviation from the standardised protocol, with use of fewer or additional question items was commonly observed.

Methodological quality assessment

For articles reporting the prevalence of disability in specific items of ADL, the median (range) methodologic score was 5 (4–6) out of a possible 8. Participant characteristics were generally adequately described, whilst the participation response rate and characteristics of patients declining participation were less frequently reported. A post-hoc decision was made not to use quality criteria in any sensitivity analysis due to the heterogeneity across studies.

ADL disability in adults with cancer

Disability relating to basic ADLs

Eighteen studies provided information about performance of basic ADLs. The mean [95% CI] prevalence of disability was 36.7% [29.8–44.3] for the overall population (see Fig. 2). There was a wide range of prevalence estimates for basic ADL disability across both inpatient (14–53%) and outpatient settings (0–86%) and significant heterogeneity across study-specific estimates (I^2 96% for both, $p < .001$). The pooled mean estimate was not statistically different according to setting (inpatient 32.0% [24.0–41.3] vs. outpatient 41.2% [31.2–51.9], $p = .19$).

Disability relating to instrumental ADLs

Fifteen studies provided information about instrumental ADLs. The mean [95% CI] prevalence of disability was 54.6% [46.5–62.3] for the overall population (see Fig. 2). Again, there was a wide range of prevalence estimates for disability across both inpatient (44–77%) and outpatient settings (13–75%) and significant heterogeneity across study-specific estimates (I^2 91 and 97%, both $p < .001$). The pooled mean estimates of disability according to study setting were borderline statistically different (inpatient 62.8% [55.2–69.8] vs. outpatient 46.1% [31.9–61.0], $p = .05$).

Number of ADLs affected and ADL disability scores

In the inpatient setting, the number of basic ADLs requiring assistance ranged from 4.7 to 5.0, and instrumental ADLs ranged from 3.0 to 4.7. In the outpatient setting, the number of basic ADLs requiring assistance ranged from 0.6 to 4.0, and instrumental ADLs ranged from 0.9 to 3.1 (Table 2). Seventeen studies provided mean total scores using a standardised instrument, which may be useful to inform future trial design. Study specific estimates from commonly used instruments across different cancer types, stages, and clinical settings are shown in Table 3.

Disability in specific ADLs

Among eight basic ADLs assessed, disability relating to personal hygiene was the most prevalent, followed by disability related to walking, transfers, and bathing. In four of the studies on walking, two reported a prevalence of disability $\geq 50\%$. The least affected activities were eating and stair climbing (Fig. 3). Among eight

instrumental ADLs assessed, disability relating to housework was most prevalent, followed by disability related to shopping and transportation. Where performance in housework was assessed, four of six studies found $\geq 50\%$ of patients reporting disability. The least affected activities were telephone use, handling finances, and medication management (Fig. 4).

Discussion

This systematic review of 43 observational studies, with 19,246 patients, reveals that about one-third of adults with cancer respectively require assistance to perform basic ADLs and about one-half require assistance to perform instrumental ADLs. Although a wide range of instruments, item and scales were used, our analysis of specific ADLs demonstrates that limitations most frequently related to the basic ADLs of personal hygiene, walking and transfer, and the instrumental ADLs of housework, shopping and transportation. Our findings highlight substantial need for rehabilitation services that focus on maintaining functional independence, and underscore an important role for professionals skilled in occupational assessment and therapy.

Measurement of ADL disability

The most common instruments in measuring ADL disability were the Katz Index of Independence in ADL and the Lawton IADL Scale. Some studies included fewer or additional ADL items using modifications of these standardised measures. A small but significant proportion of studies utilised questionnaire of selected ADL items. The use of selected items to assess ADL performance has been advocated for in clinical practice. Roehrig and colleagues [65] recommended geriatricians to use six ADL items instead of 18 items when conducting screening assessment of frail older people. This recommendation was made based on analysis of ADL data from 327 patients entered into a forward selection model. Six ADL items were sensitive in identifying 98.5% of patients with ADL related disability. Deviations from the use of standardised measures and use of self-constructed questionnaires are stumbling blocks to the advancement of science in the study of disability, as data on ADL disability could not be compared across studies or pooled together to increase power.

Reporting of ADL related disability

All the studies used dependency, defined as having difficulty to do an activity or having someone's help in at least one ADL, as an indicator of disability. A measure of dependency provides an indicator of disability, but is not a measure of disability itself [7]. Disability is often measured by the degree of difficulty (none, some, a lot, unable) or the level of help needed (minimum assistance, moderate assistance, maximum assistance) with a task. Much information about the severity of disability is therefore lost when a measure of dependency is used. Verbrugge and Jette's [7] critiqued that whilst dependency measures the need for an intervention to reduce disability, it is not discriminative in capturing the characteristics of disability, and therefore not able to provide patient-specific information about rehabilitation needs or home care support needs.

Characteristics of ADL related disability

Prevalence of ADL disability

ADL related disability was highly prevalent among adults living with cancer. Approximately one-third (37%) and half (55%) of those studied experienced difficulty of required assistance to complete basic and instrumental ADLs respectively. These findings are not

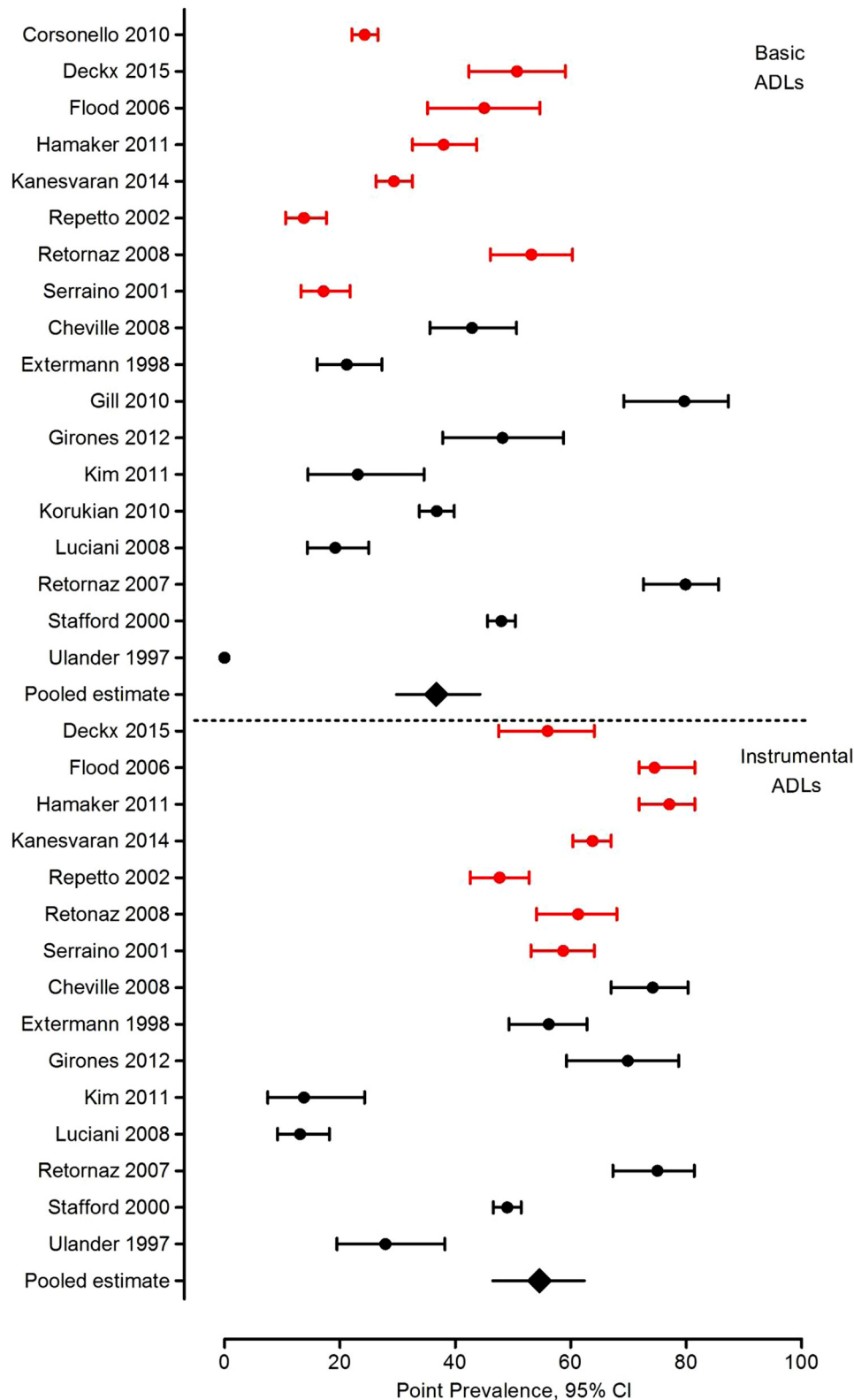


Fig. 2. Prevalence of disability in basic and instrumental ADL by study. Red lines indicate inpatient settings and black lines outpatient settings.

unexpected as literature has previously discussed the severe impact of cancer and its treatment on ADL performance. For example, Mohile et al. [14] and Stafford et al. [62] found 41% and 44% of older community-dwelling people with cancer experienced difficulty with at least one ADL. Given the high incidence of cancer worldwide, and the resultant inability to manage ADLs, manage-

ment of ADL related disability should arguably be a core part of oncology practice.

There was significant heterogeneity across study-specific prevalence estimates for disability relating to basic and instrumental ADLs. This finding likely relates to differences in the characteristics of each study. A systematic review by Harrison et al. [66] on care

needs at different phases of cancer experience found unmet care needs in ADL ranged widely (1–73%). Further analysis showed that care needs for ADLs changed according to the point in the cancer trajectory: at diagnosis (5–10%), during treatment (5–73%), post-treatment (41–47%); and during the terminal stages of illness (1–52%). This heterogeneity sheds new light on the controversy surrounding the impact of cancer and its treatment on ADLs, which warrants further study.

ADL disability higher in inpatients than outpatient

The prevalence of disability related to instrumental ADLs was higher in studies of inpatients compared to outpatients. Similarly,

Retornaz et al. [58] found 75% of 144 older people with cancer admitted to hospital with instrumental ADL disability while Jolly et al. [67] found only 23% of similar but community-dwelling group reported disability. One would expect more disability in inpatients as the inability to perform instrumental ADLs at home may be one reason for admission [68]. Such information may be useful to plan and evaluate strategies to prevent disability in out-patient oncology settings.

A hierarchical relationship in ADL

The most commonly affected basic ADL was personal hygiene, such as grooming and brushing teeth, though this finding should

Table 2

Characteristics of studies and number of ADL disabilities.

| First author | Clinical setting | ADL outcome measures | Basic ADL (mean ± SD) | Instrumental ADL (mean ± SD) |
|--------------------|------------------|-------------------------------------------------------|------------------------|------------------------------|
| Retornaz 2008 [59] | Inpatient | 6-item Katz ADL 4-item IADL scale | 5.0 ± 2.3 ^a | 3.0 ± 1.6 ^a |
| Cheville 2008 [26] | Outpatient | OARS – 7-item ADL and 7-item IADL | 1.8 ± 0.8 | 2.4 ± 2.1 |
| Girones 2012 [37] | Outpatient | 5-item Katz ADL 6-item Lawton IADL | 4.0 ± 1.0 | 3.0 ± 2.0 |
| Lunney 2003 [11] | Outpatient | Interview on 7 ADLs | 0.7 ^c | ns |
| McCarthy 2000 [52] | Outpatient | 7-item Modified Katz ADL | 1.3 ^b | ns |
| Silver 2010 [61] | Outpatient | 6-item Katz ADL 6-item Lawton IADL | 0.6 ± 1.7 | 3.1 ± 3.3 |
| Stafford 1997 | Outpatient | 6-item ADL questionnaire 6-item IADL questionnaire | 1.0 ^c | 0.9 ^c |

All values rounded to nearest decimal place.

Abbreviations: ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; ns; not stated; OARS: The Older Americans Resource and Services

^a Median was reported in study, and assumed as mean.

^b Median was reported in study, and assumed as mean. Multiple groups were combined into one group using Cochrane formula.

^c SD not specified.

Table 3

Characteristics of studies and total ADL disability score.

| First author | Clinical setting | ADL outcome measures | Range | Basic ADL (mean ± SD) | Instrumental ADL (mean ± SD) |
|---------------------|------------------|--------------------------------|----------------|-------------------------|------------------------------|
| Chen 2007 [25] | Inpatient | MDS – ADL | 0–28 | 12.6 ± 9.6 | ns |
| Cole 2000 [27] | Inpatient | FIM Motor Measure | 0–100 | 43.7 ± 6.3 ^a | ns |
| Finalyson 2012 [35] | Inpatient | MDS – ADL | 0–28 | 12.7 ± 8.2 | ns |
| Flood 2006 [36] | Inpatient | Katz Index Lawton IADL | 6–18 8–21 | 13.1 ± 2.7 | 19.7 ± 5.0 |
| Hunter 2012 [43] | Inpatient | FIM Motor Measure | 13–91 | 61 ± 17 | ns |
| Marcinak 1996 [51] | Inpatient | FIM Motor Measure | 0–100 | 42.6 ^b | ns |
| McEwen 2012 [53] | Inpatient | FIM Motor Measure | 13–91 | 58.0 ± 10.6 | ns |
| Movsas 2003 [54] | Inpatient | FIM Motor Measure | 13–91 | 72.0 ± 14.0 | ns |
| Tay 2009 [63] | Inpatient | FIM | 18–126 | 70.9 ± 18.0 | ns |
| Lindsey 1994 [49] | Outpatient | FAI ADL and IADL | 13–26 15–29 | 25.5 ± 1.2 | 28.2 ± 1.5 |
| Cheville 2009 [26] | Outpatient | FIM Mobility scale | 5–35 | 30.2 ± 5.8 | ns |
| Derks 2004 [32] | Outpatient | ADL and IADL questionnaires | ns | 19.9 ^{a,b} | 17.5 ^{a,b} |
| Hurria 2006 [44] | Outpatient | 6-item Katz ADL Lawton IADL | 6–18 8–21 | 18.0 ^b | 21.0 ^b |

All values rounded to nearest decimal place. For all outcome measures, except MDS-ADL, a lower score reflects dependence, while a higher score reflects independence.

Abbreviations: ADL: Activities of Daily Living; FAI: Functional Assessment Inventory; FIM: Functional Independence Measure; MDS – ADL: Minimum Data Set Activity of Daily Living; IADL: Instrumental Activities of Daily Living; IFS – CA: Inventory of Functional Status-Cancer; ns; not stated; OECD: Organisation for Economic Co-operation and Development.

^a Means combined from multiple samples using Cochrane formula for combining groups.

^b SD not specified in study.

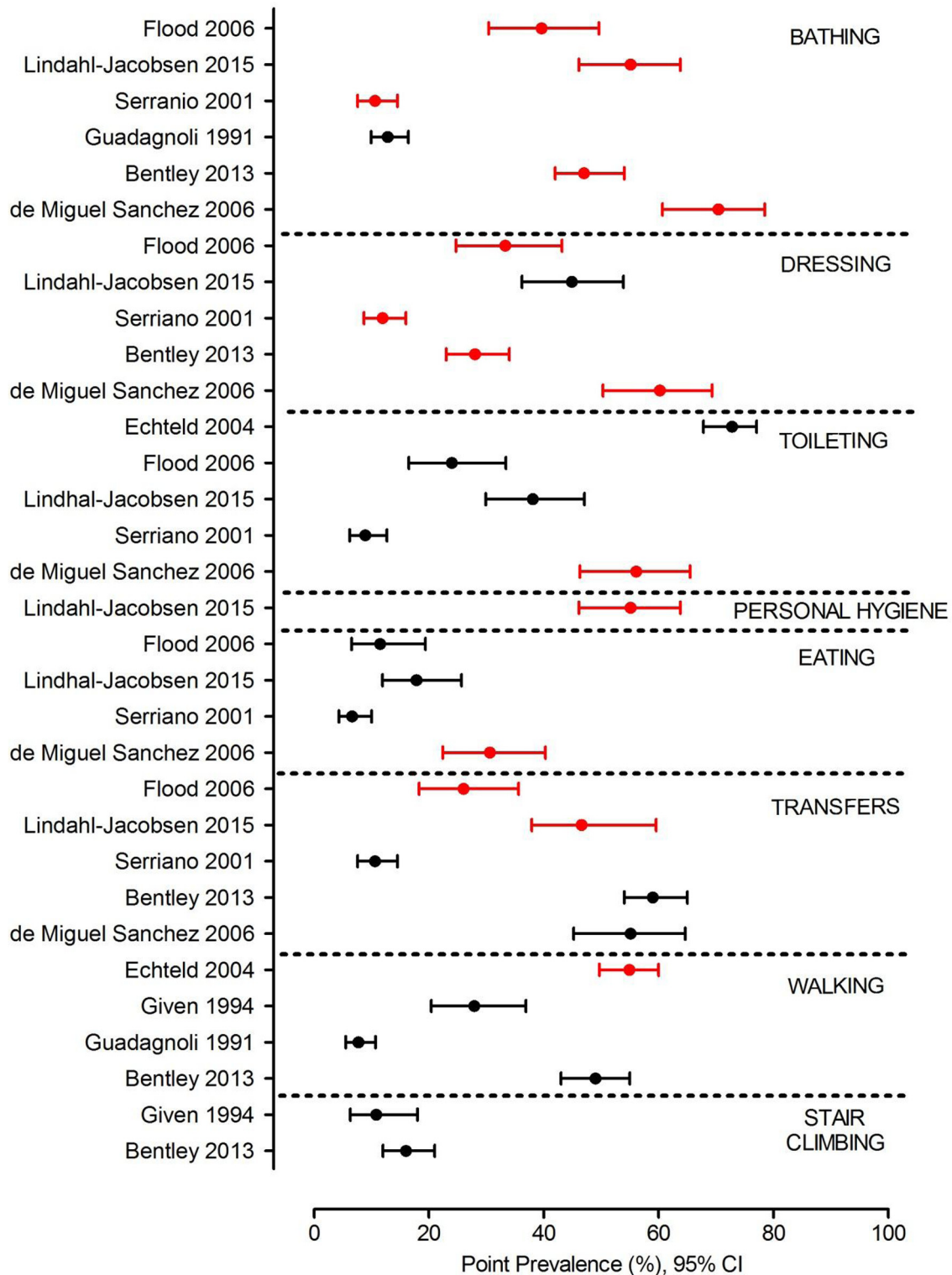


Fig. 3. Prevalence of disability in specific basic ADLs. Red lines indicate inpatient settings and black lines outpatient settings.

be interpreted with caution as the activity was only assessed in one study. Walking and transfers were also commonly affected and these findings corroborate previous studies [14,62]. Many clinicians would intuitively agree as walking and transfers as mobility tasks are physically demanding. The least affected basic ADL was eating, consistent with the order of loss in ADL functions proposed by Katz and colleagues [5,17].

Concerning instrumental ADLs, household management was most commonly affected, exemplified by the findings from Mohile et al. and Stafford et al. [14,62]. In general, instrumental ADLs requiring physical function were more commonly affected than those requiring cognitive functions. This may represent a bias in the selection and recruitment of patients into studies, e.g. excluding those without capacity to consent, but may reflect that patients

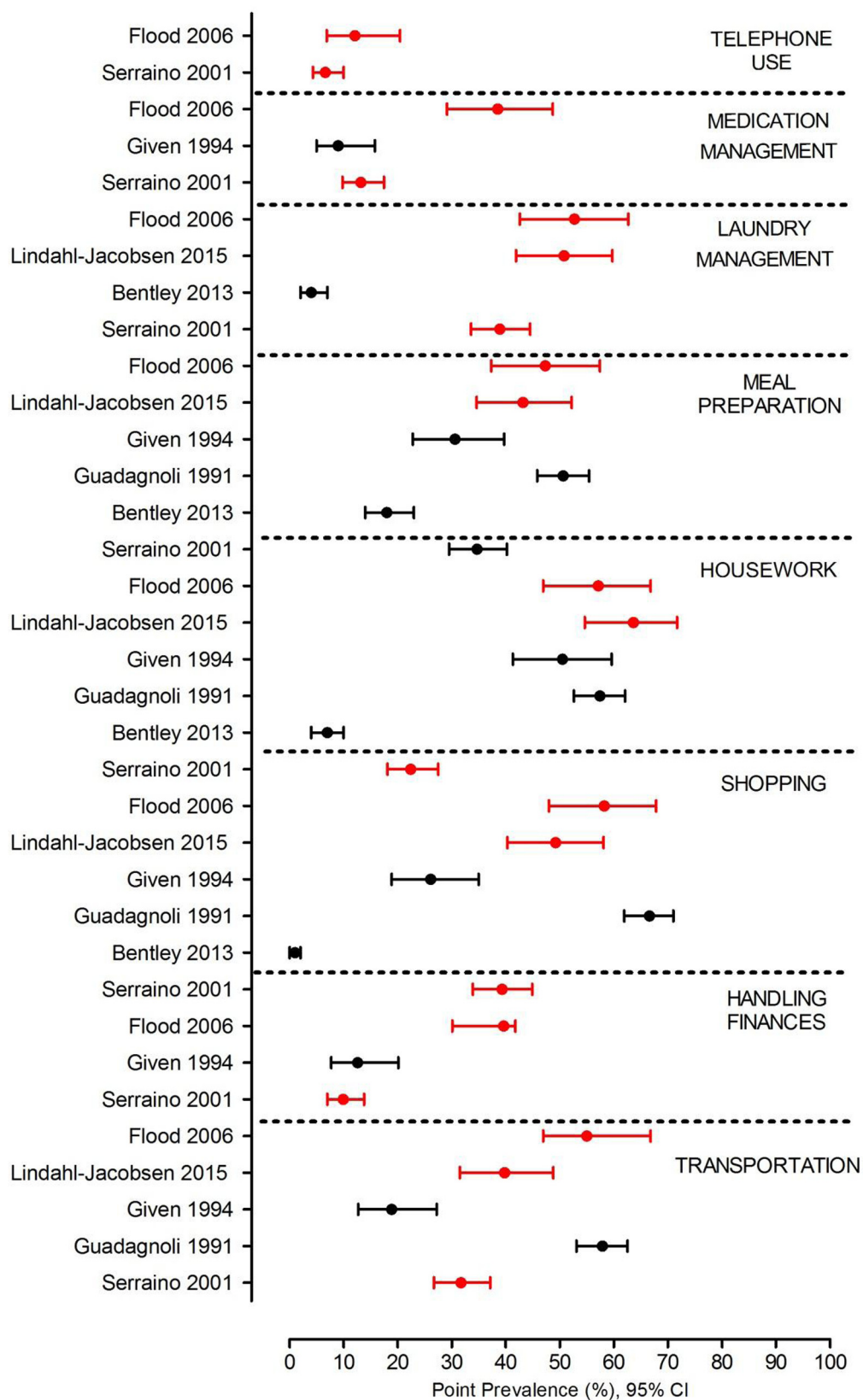


Fig. 4. Prevalence of disability in specific instrumental ADLs. Red lines indicate inpatient settings and black lines outpatient settings.

still perform cognitive tasks despite the loss of physical functions. Engaging patients in cognitive activities to maintain independence in instrumental ADL is encouraged.

Strengths and limitations

There are several strengths to this review. We developed a detailed protocol that ensured consistency and transparency in the review processes. Publication bias was minimised by utilising more than one source of information and methods to locate published and unpublished studies. Our searches were not restricted to a certain discipline and spanned health and social care databases. We also took steps to minimise judgment errors and bias, with authors' independently extracting and reviewing data. There were challenges in reaching out to experts to identify grey literature and when requesting additional data from the retrieved articles or published abstracts, which could have led to the omission of relevant on-going studies. Due to lack of time, resource (financial and expertise) and facilities for translation, we could only screen and include studies published and written in English language.

Future work

To advance the science of future studies relating to ADL disability, we encourage researchers and clinicians to work towards a consensus on the definition of disability to influence more uniform measurement of ADL disability.

We strongly advocate for the use of standardised, validated instruments over local variations. Use of validated tools which consider ADLs, for example the Lawton IADL Scale or the Functional Independence Measure, would allow data to be reliably compared across future studies and populations. We suggest that subjective measures of dependency used as proxies for disability, or simply summing the number of ADLs that require assistance, does not portray the full nature or extent of ADL related disability. Future research in this field could consider the degree of difficulty, type and level of assistance required to perform specific activities. Finally, intervention studies targeting the maintenance of ADL in people living with cancer, including advanced and progressive disease, should select valid and sensitive scales to help identify, develop and evaluate the best approaches.

Conclusions

This systematic review has identified the nature and prevalence of ADL related disability in adults living with cancer. Overall, about one-third and half of adults with cancer respectively have difficulty or require assistance to perform basic and instrumental ADLs across both inpatient and outpatients settings. Our findings provide useful insights for health care professionals to plan and deliver rehabilitation services, and highlight a particular need for rehabilitation focused on functional independence. The most frequently affected ADLs were personal hygiene, walking and transfers, housework, and shopping and transportation. This understanding can help clinicians focus attention and anticipate problems on activities most commonly affected by cancer. Our findings also underscore the importance of professionals skilled in occupational assessment and therapy in cancer care.

Declaration of interests

MM and IJH received funding from the National Institute for Health Research and from Cicely Saunders International. MM received personal fees from Helsinn and Chugai UK outside the

submitted work. JN, LF and GW declare no competing interests. These funders had no role in review design, data analysis, data interpretation, or writing of this report. The corresponding author had full access to articles reporting data used in the review and had final responsibility for the decision to submit for publication.

Competing interests

None of the authors have any competing interests to declare.

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Contributors

Substantial contributions to the conception and design of the study: JN, MM; substantial contribution to the acquisition of Data: JN, LF, MM; Analysis and interpretation of the data: JN, GW, LF, IJH, MM; First draft of the manuscript: JN, MM; Revision of the manuscript critically for important intellectual content: All authors; Approval of the final manuscript: All authors; Accountability for all aspects of the work: JN, MM.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.ctrv.2017.10.006>.

References

- [1] Silver JK, Baima J, Mayer RS. Impairment-driven cancer rehabilitation: an essential component of quality care and survivorship. *CA Cancer J Clin* 2013;63:295–317.
- [2] Covinsky K. Aging, arthritis, and disability. *Arthritis Rheum* 2006;55:175–6.
- [3] Fricke J. Activities of daily living. In: Stone JH, Blouin M, editors. *International encyclopedia of rehabilitation*; 2010.
- [4] Fillenbaum GG, Smyer MA. The development, validity, and reliability of the OARS multidimensional functional assessment questionnaire. *J Gerontol* 1981;36:428–34.
- [5] Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of adl: a standardized measure of biological and psychosocial function. *JAMA* 1963;185:914–9.
- [6] Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *The Gerontologist* 1969;9:179–86.
- [7] Verbrugge LM, Jette AM. The disablement process. *Soc Sci Med* 1982;1994 (38):1–14.
- [8] Christiansen C, Baum CM, Bass-Haugen J. *Occupational therapy: performance, participation, and well-being*. NJ: Slack Thorofare; 2005.
- [9] Christiansen CH, Hammecker CL. Self care. In: Bonder BR, Wagner MB, editors. *Functional performance in older adults*. Philadelphia: F.A. Davis; 2001. p. 155–175.
- [10] Manton KG. A longitudinal study of functional change and mortality in the United States. *J Gerontol* 1988;43:S153–61.
- [11] Lunney JR, Lynn J, Foley DJ, Lipson S, Guralnik JM. Patterns of functional decline at the end of life. *JAMA* 2003;289:2387–92.
- [12] Gill TM, Gahbauer EA, Han L, Allore HG. Trajectories of disability in the last year of life. *N Engl J Med* 2010;362:1173–80.
- [13] Girones R, Torregrosa D, Diaz-Beveridge R. Comorbidity, disability and geriatric syndromes in elderly breast cancer survivors. Results of a single-center experience. *Crit Rev Oncol/Hematol* 2010;73:236–45.
- [14] Mohile SG, Xian Y, Dale W, Fisher SG, Rodin M, Morrow GR, et al. Association of a cancer diagnosis with vulnerability and frailty in older Medicare beneficiaries. *J Natl Cancer Inst* 2009;101:1206–15.
- [15] Whittle H, Goldenberg D. Functional health status and instrumental activities of daily living performance in noninstitutionalized elderly people. *J Adv Nurs* 1996;23:220–7.

- [16] Fodeh SJ, Lazenby M, Bai M, Ercolano E, Murphy T, McCorkle R. Functional impairments as symptoms in the symptom cluster analysis of patients newly diagnosed with advanced cancer. *J Pain Symptom Manage* 2013;46:500–10.
- [17] Katz S, Akpom CA. A measure of primary sociobiological functions. *Int J Health Services: Plan Administration Eval* 1976;6:493–508.
- [18] (CRD) Cfrad. Systematic reviews: CRD's guidance for undertaking reviews in health care. York (UK): Centre for Reviews and Dissemination, University of York; 2009.
- [19] Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *J Clin Epidemiol* 2009;62:1006–12.
- [20] Feuerstein M. Defining cancer survivorship. *J Cancer Survivorship: Res Pract* 2007;1:5–7.
- [21] Loney PL, Chambers LW, Bennett KJ, Roberts JG, Stratford PW. Critical appraisal of the health research literature: prevalence or incidence of a health problem. *Chronic Dis Canada* 1998;19:170–6.
- [22] Higgins J, Green S. *Cochrane handbook for systematic reviews of interventions*; 2011 [2015].
- [23] Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. *BMC Med Res Methodol* 2005;5:13.
- [24] Bentley R, Hussain A, Maddocks M, Wilcock A. Occupational therapy needs of patients with thoracic cancer at the time of diagnosis: findings of a dedicated rehabilitation service. *Supportive Care Cancer: Off J Multinational Assoc Supportive Care Cancer* 2013;21:1519–24.
- [25] Chen JH, Chan DC, Kiely DK, Morris JN, Mitchell SL. Terminal trajectories of functional decline in the long-term care setting. *J Gerontol Ser A, Biol Sci Med Sci* 2007;62:531–6.
- [26] Cheville AL, Troxel AB, Basford JR, Kornblith AB. Prevalence and treatment patterns of physical impairments in patients with metastatic breast cancer. *J Clin Oncol: Off J Am Soc Clin Oncol* 2008;26:2621–9.
- [27] Cole RP, Scialla SJ, Bednarz L. Functional recovery in cancer rehabilitation. *Arch Phys Med Rehabil* 2000;81:623–7.
- [28] Corsonello A, Pedone C, Carosella L, Corica F, Mazzei B, Incalzi RA. Health status in older hospitalized patients with cancer or non-neoplastic chronic diseases. *BMC Geriatrics* 2005;5:10.
- [29] Deckx L, van den Akker M, Daniels L, De Jonge ET, Bulens P, Tjan-Heijnen VC, et al. Geriatric screening tools are of limited value to predict decline in functional status and quality of life: results of a cohort study. *BMC Family Pract* 2015;16:30.
- [30] Deeg DJ. Longitudinal characterization of course types of functional limitations. *Disabil Rehabil* 2005;27:253–61.
- [31] de Miguel Sanchez C, Elustondo SG, Estirado A, Sanchez FV, de la Rasilla Cooper CG, Romero AL, et al. Palliative performance status, heart rate and respiratory rate as predictive factors of survival time in terminally ill cancer patients. *J Pain Symptom Manage* 2006;31:485–92.
- [32] Derks W, De Leeuw R, Winnubst J, Hordijk GJ. Elderly patients with head and neck cancer: physical, social and psychological aspects after 1 year. *Acta Otolaryngol* 2004;124:509–14.
- [33] Echteld MA, Deliens L, Van Der Wal G, Ooms ME, Ribbe MW. Palliative care units in The Netherlands: changes in patients' functional status and symptoms. *J Pain Symptom Manage* 2004;28:233–43.
- [34] Extermann M, Overcash J, Lyman GH, Parr J, Balducci L. Comorbidity and functional status are independent in older cancer patients. *J Clin Oncol: Off J Am Soc Clin Oncol* 1998;16:1582–7.
- [35] Finlayson E, Zhao S, Boscardin WJ, Fries BE, Landefeld CS, Dudley RA. Functional status after colon cancer surgery in elderly nursing home residents. *J Am Geriatr Soc* 2012;60:967–73.
- [36] Flood KL, Carroll MB, Le CV, Ball L, Esker DA, Carr DB. Geriatric syndromes in elderly patients admitted to an oncology-acute care for elders unit. *J Clin Oncol: Off J Am Soc Clin Oncol* 2006;24:2298–303.
- [37] Girones R, Torregrosa D, Gomez-Codina J, Maestu I, Tenias JM, Rosell R. Lung cancer chemotherapy decisions in older patients: the role of patient preference and interactions with physicians. *Clin Translational Oncol: Off Publ Fed Spanish Oncol Soc Natl Cancer Inst Mexico* 2012;14:183–9.
- [38] Given CW, Given BA, Stommel M. The impact of age, treatment, and symptoms on the physical and mental health of cancer patients. A longitudinal perspective. *Cancer* 1994;74:2128–38.
- [39] Greimel ER, Freidl W. Functioning in daily living and psychological well-being of female cancer patients. *J Psychosom Obstet Gynaecol* 2000;21:25–30.
- [40] Guadagnoli E, Mor V. Daily living needs of cancer outpatients. *J Community Health* 1991;16:37–47.
- [41] Hamaker ME, Buurman BM, van Munster BC, Kuper IM, Smorenburg CH, de Rooij SE. The value of a comprehensive geriatric assessment for patient care in acutely hospitalized older patients with cancer. *Oncologist* 2011;16:1403–12.
- [42] Huijberts S, Buurman BM, de Rooij SE. End-of-life care during and after an acute hospitalization in older patients with cancer, end-stage organ failure, or frailty: a sub-analysis of a prospective cohort study. *Palliat Med* 2016;30:75–82.
- [43] Hunter EG, Baltisberger J. Functional outcomes by age for inpatient cancer rehabilitation: a retrospective chart review. *J Appl Gerontol: Off J Southern Gerontol Soc* 2013;32:443–56.
- [44] Hurria A, Hurria A, Zuckerman E, Panageas KS, Fornier M, D'Andrea G, et al. A prospective, longitudinal study of the functional status and quality of life of older patients with breast cancer receiving adjuvant chemotherapy. *J Am Geriatr Soc* 2006;54:1119–24.
- [45] Kanesvaran R, Wang W, Yang Y, Wei Z, Jia L, Li F, et al. Characteristics and treatment options of elderly Chinese patients with cancer as determined by Comprehensive Geriatric Assessment (CGA). *J Geriatr Oncol* 2014;5:171–8.
- [46] Kim YJ, Kim JH, Park MS, Lee KW, Kim KI, Bang SM, et al. Comprehensive geriatric assessment in Korean elderly cancer patients receiving chemotherapy. *J Cancer Res Clin Oncol* 2011;137:839–47.
- [47] Koroukian SM, Xu F, Bakaki PM, Diaz-Insua M, Towe TP, Owusu C. Comorbidities, functional limitations, and geriatric syndromes in relation to treatment and survival patterns among elders with colorectal cancer. *J Gerontol Ser A, Biol Sci Med Sci* 2010;65:322–9.
- [48] Lindahl-Jacobsen L, Hansen DG, Waehrens EE, la Cour K, Sondergaard J. Performance of activities of daily living among hospitalized cancer patients. *Scand J Occup Ther* 2015;22:137–46.
- [49] Lindsey AM, Larson PJ, Dodd MJ, Brecht ML, Packer A. Comorbidity, nutritional intake, social support, weight, and functional status over time in older cancer patients receiving radiotherapy. *Cancer Nurs* 1994;17:113–24.
- [50] Luciani A, Jacobsen PB, Extermann M, Foa P, Marussi D, Overcash JA, et al. Fatigue and functional dependence in older cancer patients. *Am J Clin Oncol* 2008;31:424–30.
- [51] Marciniak CM, Sliwa JA, Spill G, Heinemann AW, Semik PE. Functional outcome following rehabilitation of the cancer patient. *Arch Phys Med Rehabil* 1996;77:54–7.
- [52] McCarthy EP, Phillips RS, Zhong Z, Drews RE, Lynn J. Dying with cancer: patients' function, symptoms, and care preferences as death approaches. *J Am Geriatr Soc* 2000;48:S110–21.
- [53] McEwen SE, Elmi S, Waldman M, Bishev M. Inpatient oncology rehabilitation in Toronto: a descriptive 18-month retrospective record review. *Supportive Care Cancer: Off J Multinational Assoc Supportive Care Cancer* 2012;20:1541–7.
- [54] Movsas SB, Chang VT, Tunkel RS, Shah VV, Ryan LS, Millis SR. Rehabilitation needs of an inpatient medical oncology unit. *Arch Phys Med Rehabil* 2003;84:1642–6.
- [55] O'Hare PA, Malone D, Lusk E, McCorkle R. Unmet needs of black patients with cancer posthospitalization: a descriptive study. *Oncol Nurs Forum* 1993;20:659–64.
- [56] Ogce F, Ozkan S. Changes in functional status and physical and psychological symptoms in women receiving chemotherapy for breast cancer. *Asian Pac J Cancer Prevent: APJCP* 2008;9:449–52.
- [57] Repetto L, Fratio L, Audisio RA, Venturino A, Gianni W, Vercelli M, et al. Comprehensive geriatric assessment adds information to Eastern Cooperative Oncology Group performance status in elderly cancer patients: an Italian Group for Geriatric Oncology Study. *J Clin Oncol* 2002;20:494–502.
- [58] Retornaz F, Seux V, Sourial N, Braud AC, Monette J, Bergman H, et al. Comparison of the health and functional status between older inpatients with and without cancer admitted to a geriatric/internal medicine unit. *J Gerontol Ser A, Biol Sci Med Sci* 2007;62:917–22.
- [59] Retornaz F, Seux V, Pauly V, Soubeyrand J. Geriatric assessment and care for older cancer inpatients admitted in acute care for elders unit. *Crit Rev Oncol/Hematol* 2008;68:165–71.
- [60] Serraino D, Fratio L, Zagonel V. Prevalence of functional disability among elderly patients with cancer. *Crit Rev Oncol/Hematol* 2001;39:269–73.
- [61] Silver HJ, de Campos Graf Guimaraes C, Pedruzzi P, Badia M, Spuldaro de Carvalho A, Oliveira BV, et al. Predictors of functional decline in locally advanced head and neck cancer patients from south Brazil. *Head Neck* 2010;32:1217–25.
- [62] Stafford RS, Cyr PL. The impact of cancer on the physical function of the elderly and their utilization of health care. *Cancer* 1997;80:1973–80.
- [63] Tay SS, Ng YS, Lim PA. Functional outcomes of cancer patients in an inpatient rehabilitation setting. *Ann Acad Med Singapore* 2009;38:197–201.
- [64] Ulander K, Jeppsson B, Grahm G. Quality of life and independence in activities of daily living preoperatively and at follow-up in patients with colorectal cancer. *Supportive Care Cancer: Off J Multinational Assoc Supportive Care Cancer* 1997;5:402–9.
- [65] Roehrig B, Hoeffken K, Pientka L, Wedding U. How many and which items of activities of daily living (ADL) and instrumental activities of daily living (IADL) are necessary for screening. *Crit Rev Oncol/Hematol* 2007;62:164–71.
- [66] Harrison JD, Young JM, Price MA, Butow PN, Solomon MJ. What are the unmet supportive care needs of people with cancer? A systematic review. *Supportive Care Cancer: Off J Multinational Assoc Supportive Care Cancer* 2009;17:1117–28.
- [67] Jolly TA, Deal AM, Nyrop KA, Williams GR, Pergolotti M, Wood WA, et al. Geriatric assessment-identified deficits in older cancer patients with normal performance status. *Oncologist* 2015;20:379–85.
- [68] Boyd CM, Ricks M, Fried LP, Guralnik JM, Xue QL, Xia J, et al. Functional decline and recovery of activities of daily living in hospitalized, disabled older women: the Women's Health and Aging Study I. *J Am Geriatr Soc* 2009;57:1757–66.